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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/600,226	06/19/2003	Sung Gu Kang	CDDC/CHC/011	9786

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FENWICK & WEST LLP
SILICON VALLEY CENTER
801 CALIFORNIA STREET
MOUNTAIN VIEW, CA 94041

EXAMINER	
SANTIAGO, MARICELI	
ART UNIT	**PAPER NUMBER**
2879	

DATE MAILED: 02/09/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/600,226	KANG ET AL.	
	Examiner	Art Unit	
	Mariceli Santiago	2879	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☒ Claim(s) *7-14* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *19 June 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

Claim 5 is objected to because in line 2, the term "environment" is followed by a period, claims are required to consist of a single sentence ending in a period, except when a period is used for abbreviations.

Claims 13 and 14 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claims, or amend the claims to place the claims in proper dependent form, or rewrite the claims in independent form. Claim 13 recites "said additive gas comprises NH_3", and claim 14 recites "said additive gas comprises H_2", the recitations fail to further limit the subject matter of the previous claim 8 which already recites "a mixture of NH_3 and H_2".

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation "said substrate" in line 11. There is insufficient antecedent basis for this limitation in the claim.

Regarding claim 1, in lines 6-7, the recitation "upon which said plurality of carbon nanotubes is disposed" renders the claim indefinite since the nanotubes would not have been formed at this stage but at a later stage during growing of the carbon nanotubes by plasma

source gas. Claims 2-15 are indefinite for the same reasons as stated in claim 1, because of their dependency status.

Regarding claims 11 and 12, it is unclear how the plasma source gas comprises a capacitively coupled plasma source as previously stated in claim 10, and further comprise an inductively-type and a microwave-type plasma source. For examination purposes the Examiner will assume that the plasma source is a capacitively, inductively or microwave type plasma source and not a combination of all.

Claims 13 and 14 recite the limitation "said additive gas". There is insufficient antecedent basis for this limitation in the claims.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chuang et al (US 6,062,931) in view of Jang et al. (US 6,331,209).

Regarding claim 1, Chuang discloses a method of forming carbon nanotubes in a flat panel display device comprising granulizing a catalyst layer to generate nano-particles and to

provide a voluminous surface area for growing a plurality of carbon nanotubes, heating the catalyst layer upon which the plurality of carbon nanotubes is disposed to a temperature of about 300°C to 500°C, soaking the catalyst layer in a soaking gas, and growing the plurality of carbon nanotubes by exposing the substrate to a plasma source gas. Chuang is silent in regards to the limitation of the density of the plasma source gas, specifically of $10^{10} - 10^{12}$ cm^{-3}. In the same field of endeavor, Jang discloses a method of manufacturing carbon nanotubes comprising the step of growing the plurality of carbon nanotubes from a catalyst layer by exposing the substrate to a plasma source gas at a density of 10^{11} cm^{-3} or more in order to obtain an effective high-density plasma source. Moreover, Jang's teaching suggests a reasonable expectation for an efficient performance of the plasma source within the disclosed density values, when use in the growth of carbon nanotubes from a catalyst layer. Thus, it would have been obvious at the time the invention was made to a person having ordinary skills in the art to incorporate the plasma source density disclosed by Jang in the method of Chuang in order to efficiently grow carbon nanotubes from a catalyst layer by use of a high-density plasma source.

Regarding claim 15, Chuang discloses a method wherein the catalyst layer is disposed on a glass substrate.

Claims 2-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chuang et al (US 6,062,931) in view of Jang et al. (US 6,331,209), and further in view of Resasco et al (WO 01/94260 A1).

Regarding claim 2, Chuang discloses a method wherein the soaking gas is ammonia, Chuang fails to disclose the limitation of the soaking gas is a hydrocarbon containing gas. However, in the same field of endeavor, Resasco discloses a method wherein the catalyst particles are soaked in a reducing gas selected from ammonia, methane and hydrogen. It has

been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. Thus, it would have been obvious to one having ordinary skills in the art at the time the invention was made to use methane as soaking gas since the selection of a hydro-carbon containing gas would have a reasonable expectation to effectively perform as a soaking gas as suggested by Resasco's teaching.

Regarding claim 3, the combined references disclose a method wherein the catalyst layer is soaked with a hydro-carbon gas prior to growing the carbon nanotubes and the catalyst granules are diffuse into the carbon nanotubes as the plurality of carbon nanotubes are formed, thus it would have been reasonable to expect that the soaking process enhances the diffusion of the granules into the plurality of carbon nanotubes.

Regarding claim 4, Chuang disclose a method wherein the catalyst layer is soaked in the soaking gas at a temperature of 500°C for approximately 10-30 minutes.

Regarding claim 5, Chuang-Jang-Resasco disclose a method wherein the catalyst layer is soaked in a vacuum environment, the plurality of carbon nanotubes are formed on the granules of catalyst layer using a plasma chemical vapor deposition process at high plasma pressure. While Chuang is silent in regards to the pressure of the plasma source, Jang further teaches a high plasma pressure of 0.5 Torr to 10 Torr, accordingly, it would have been obvious to use plasma pressures within the claimed range with a reasonable expectation of success as suggested by Jang's teachings. Thus, it would have been obvious at the time the invention was made to a person having ordinary skills in the art to incorporate the plasma source density disclosed by Jang in the method of Chuang since Jang's teaching suggest a reasonable expectation for an efficient performance of the plasma source within the claimed pressure values.

Regarding claim 6, Chuang discloses a method wherein the plasma source comprises CH_4.

Claims 1-4 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Resasco et al (WO 01/94260 A1) in view of Jang et al. (US 6,331,209).

Regarding claims 1, 2, Resasco discloses a method of forming carbon nanotubes in a flat panel display device comprising granulizing a catalyst layer to generate nano-particles and to provide a voluminous surface area for growing a plurality of carbon nanotubes, heating the catalyst layer to a temperature of about 300°C to 500°C (Page 24, lines 1-3), soaking the catalyst layer in a hydro-carbon containing soaking gas (Page 24, lines 15-18), and growing the plurality of carbon nanotubes by exposing the substrate to a plasma source gas containing CH_4 (Page 26, lines 1-3). Resasco is silent in regards to the limitation of the density of the plasma source gas, specifically of $10^{10} - 10^{12}$ cm^{-3}. In the same field of endeavor, Jang discloses a method of manufacturing carbon nanotubes comprising the step of growing the plurality of carbon nanotubes from a catalyst layer by exposing the substrate to a plasma source gas at a density of 10^{11} cm^{-3} or more in order to obtain an effective high-density plasma source. Moreover, Jang's teaching suggests a reasonable expectation for an efficient performance of the plasma source within the disclosed density values, when use in the growth of carbon nanotubes from a catalyst layer. Thus, it would have been obvious at the time the invention was made to a person having ordinary skills in the art to incorporate the plasma source density disclosed by Jang in the method of Resasco in order to efficiently grow carbon nanotubes from a catalyst layer by use of a high-density plasma source.

Regarding claim 3, Resasco discloses a method wherein the catalyst layer is soaked with a hydro-carbon gas prior to growing the carbon nanotubes and the catalyst granules are diffuse into the carbon nanotubes as the plurality of carbon nanotubes are formed, thus it would

have been reasonable to expect that the soaking process enhances the diffusion of the granules into the plurality of carbon nanotubes.

Regarding claim 4, Resasco discloses a method wherein the catalyst layer is soaked in the soaking gas at a temperature range including 400°C to 500°C. While Resasco is silent in regards to the time range for the soaking step, one of ordinary skills in the art would be capable to estimated the time required for effectively soak the catalyst layer as an obvious matter of design engineering. Thus, it would have been obvious at the time the invention was made to a person having ordinary skills in the art to incorporate a time range between 1-30 minutes in the method of Resasco since the estimation of a time period required for effective performance of the soaking gas would be recognized as an obvious matter of design engineering.

Regarding claim 15, Resasco discloses a method wherein the catalyst layer is disposed on a glass substrate (Page 18, lines 11-15).

Allowable Subject Matter

Claims 7-14 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 11-14 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 7, the references of the Prior Art of record fails to teach or suggest the combination of the limitations as set forth in claim 7, and specifically comprising the limitation of the hydro-carbon containing gas comprises C_2H_2.

Regarding claims 8-14, claims 8-14 are allowable for the reasons given in claim 7 because of their dependency status from claim 7.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mariceli Santiago whose telephone number is (571) 272-2464. The examiner can normally be reached on Monday-Friday from 9:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimesh Patel, can be reached on (571) 272-2457. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

2/5/05
Mariceli Santiago
Patent Examiner
Art Unit 2879